Fault Detection and Diagnostics Automated Correction Partner's Kickoff Meeting

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Agenda

- Introductions
- Project Motivation and Goals
- Partner Roles
- Timeline
- Discussion
- Next Steps

Introductions

- Implementation Partners
  - KGS Buildings
  - kW Engineering
  - CopperTree Analytics
  - LBNL Sustainability Group

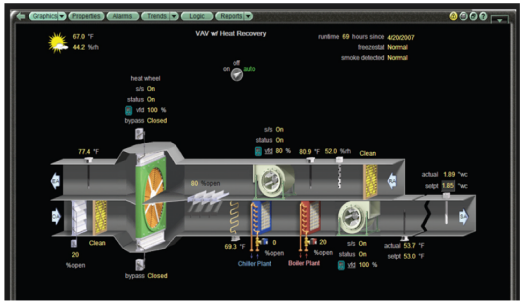
- Advisory Partners
  - Altura Associates
  - Buildpulse
  - Kodaro
  - Group 14
  - EcoVox

Motivation

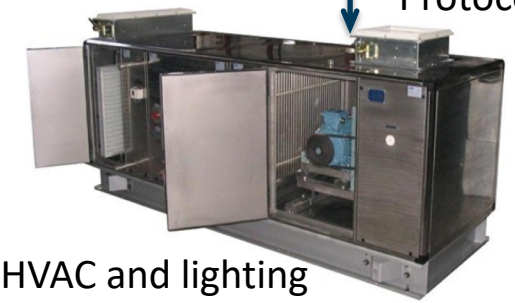
- Current FDD products continuously identify faults through a 1-way BAS interface, *enabling* savings of 5-15%
  - human intervention to fix faults results in delay/inaction, lost opportunity, and additional O&M cost
  - Automated fault correction promises to advance usability and performance

Software with FDD code and auto-correction routines

BACnet



BACnet/Other Protocol



Controlled HVAC and lighting equipment

Goals

- Develop library of automated FDD correction routines
- Integrate with commercial FDD products (development environments)
- Field test efficacy and document findings
- Evaluate market potential and benefits
- Broadly disseminate findings

Partners' Role

- Implementation Partners
  - Site recruitment, selection, field test
  - Input and feedback on Test Plan
  - Contribute to ID-ing auto-correction routines
  - Implement routines in FDD platform code
  - Monitor sites per test plan and document findings
  - Feedback on market potential evaluation

- Advisory Partners
  - Provide feedback, input where most interested to contribute
  - Stay apprised of, and adopt findings as appropriate
  - Support awareness building and dissemination as appropriate

Timeline for Year 1 – Year 3

Year 1

- Literature review and library of correction routines
- Test Plan
- Site selection

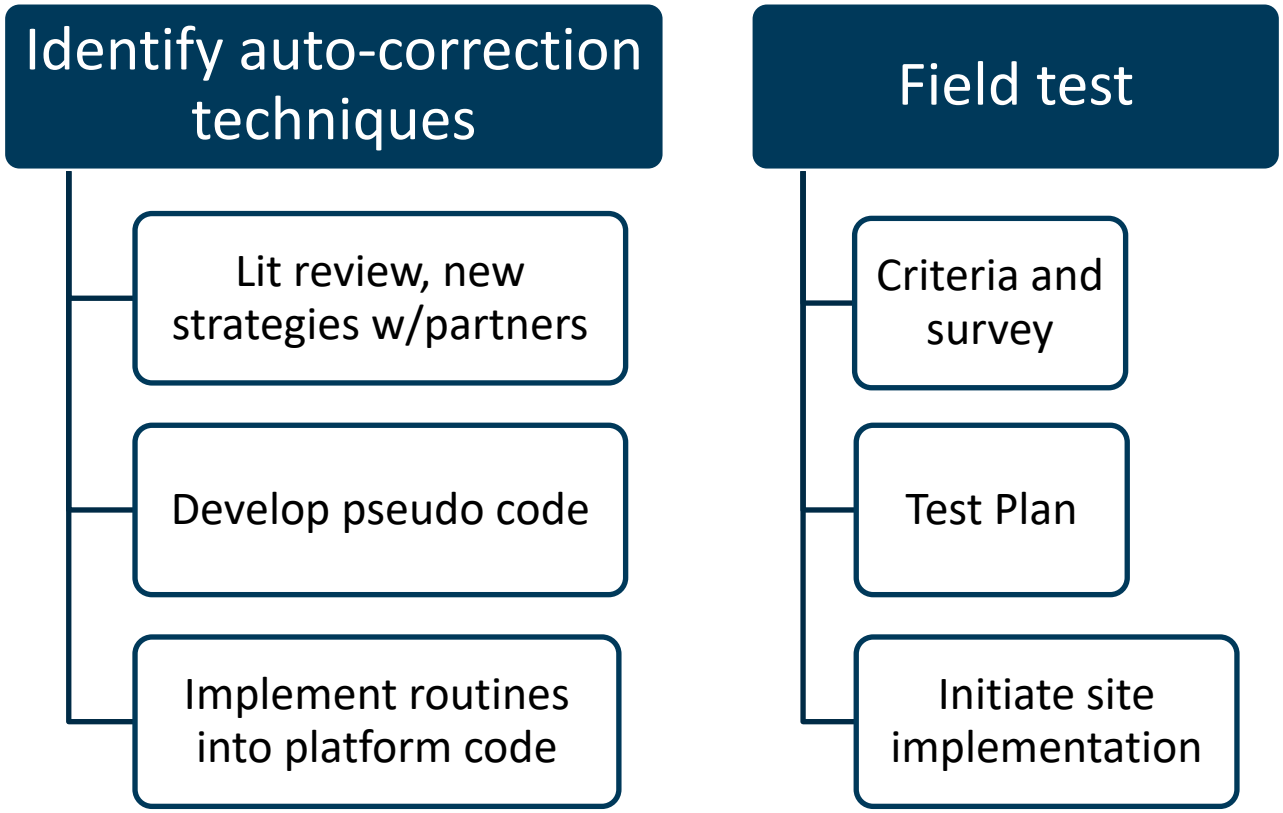
Year 2

- Rollout to sites
- Document implementation

Year 3

- Evaluate performance and market potential
- Publish and share findings

Targeted Activity for Year 1



Literature Review and Library of Correction Routines (Q1-Q3)

- Existing documentation of fault types, catalogue those that can be corrected with automation as opposed to a physical ‘wrench turn’
- Define techniques to correct the faults identified Supplement solutions from the literature and partners with newly developed logical routines
- Publish results in a library of publicly available ‘open source’ pseudo code

Example of Auto-Correction Routine

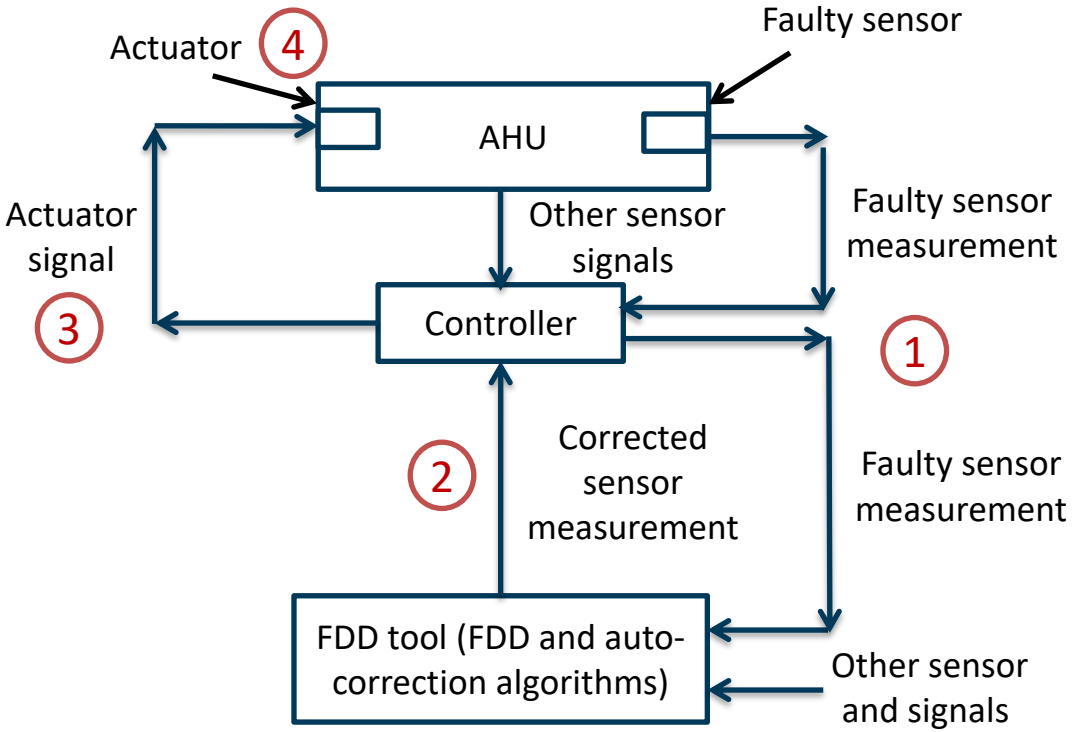
- Biased sensor fault

(1) The faulty sensor measurement and other signals are fed into FDD tool

(2) The FDD tool detects, diagnoses, characterizes the bias sensor fault, then sends corrected sensor measurement to the controller

(3) The controller produces correct actuator signal

(4) The actuator responds to the actuator signal by instigating an action

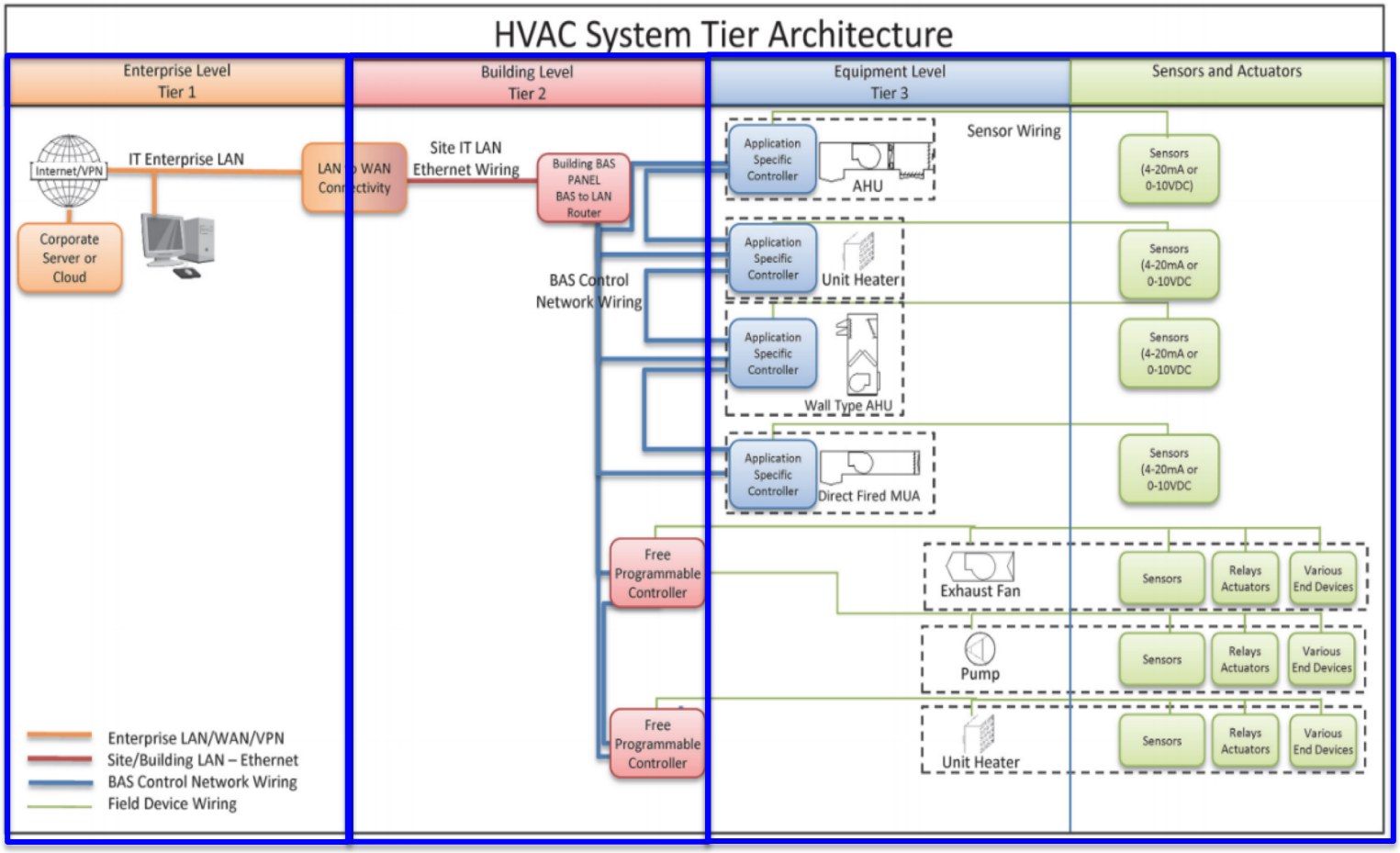


Fault Categories

- Possible auto-correctable faults (faults that deviates from existing sequences and opportunities for operation improvements)
  - Automatic control overridden too long
  - Unscheduled operation during unoccupied hours
  - Biased sensors
  - Damper/valve control hunting
  - Schedules not optimally defined
  - Setpoints not optimally defined (e.g. temp. , pressure, min. damper position setpoints too high/low)
  - Others?

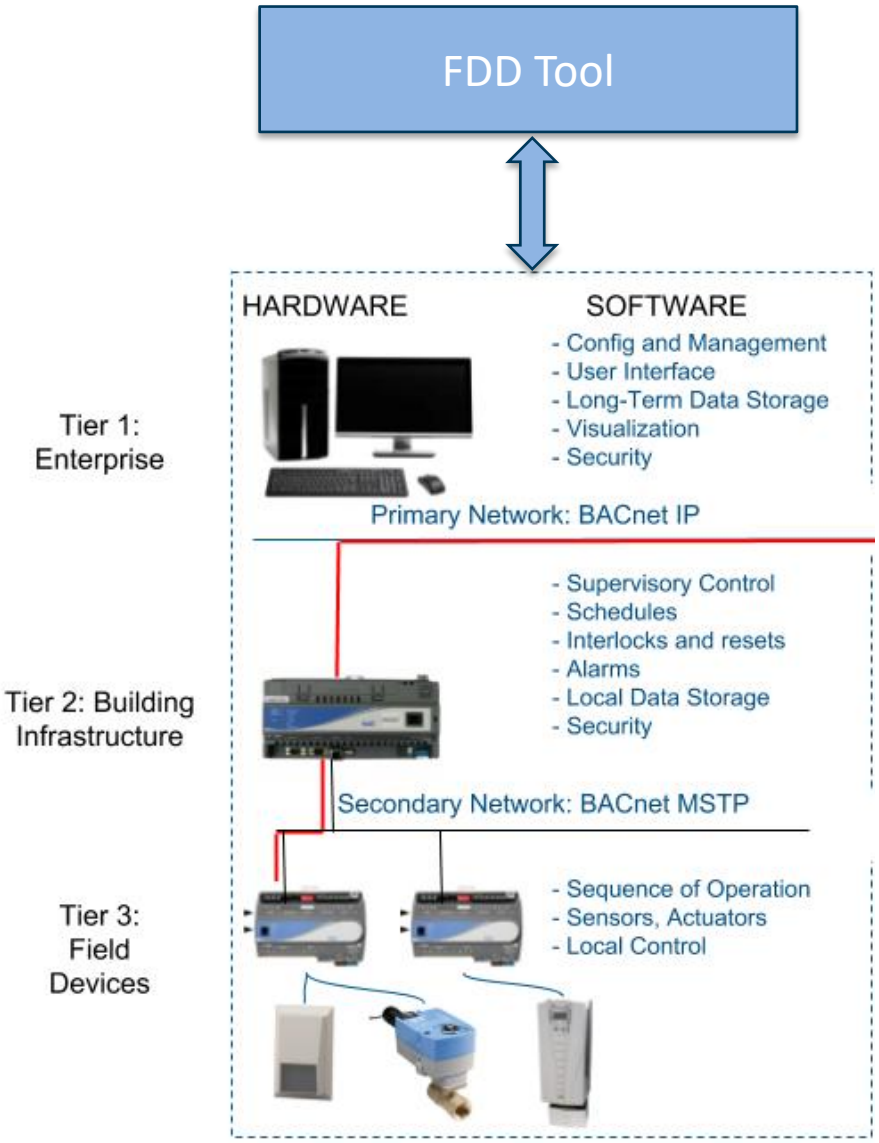
- Not auto–correctable faults
  - Component failure
  - Under/oversized component
  - Damper/valve stuck/leakage
  - Control signal offline
  - Others?

Fault Auto-Correction Architecture



Tier 1 Tier 2 Tier 3

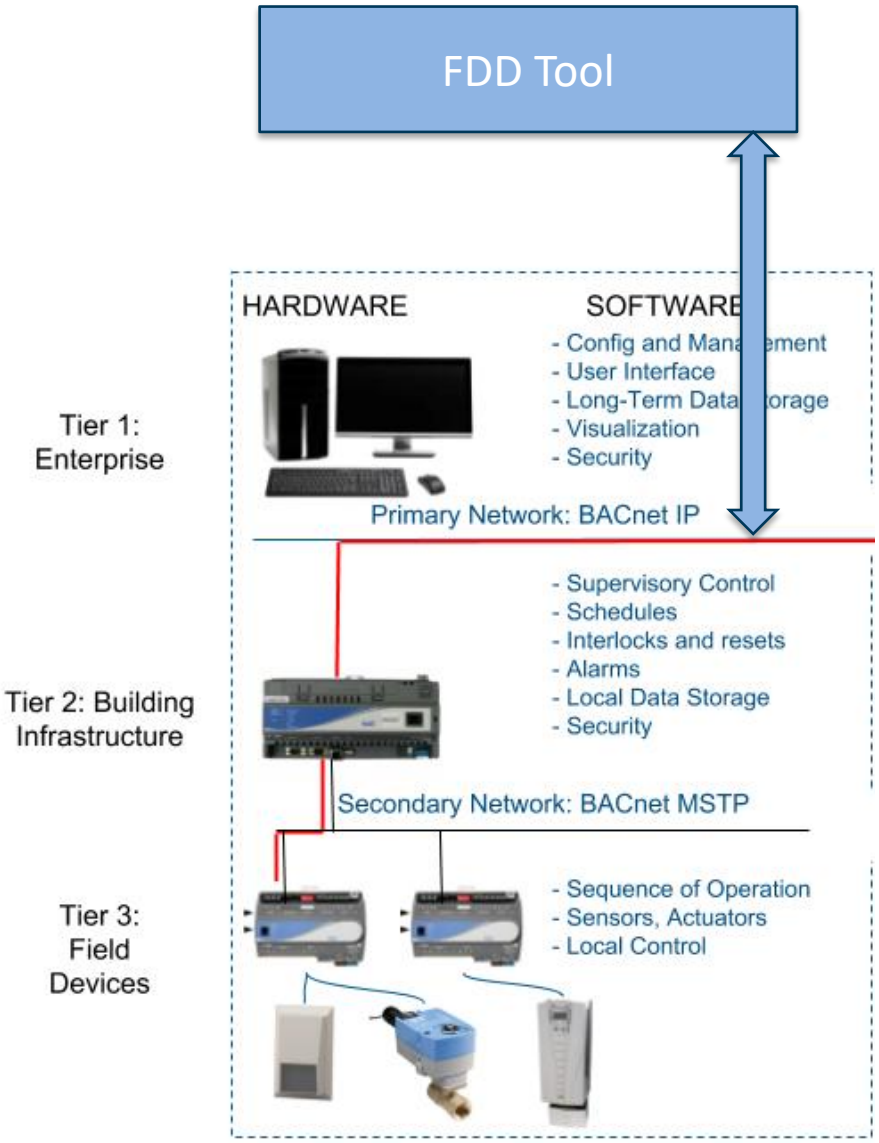
Fault Auto-Correction Architecture



Integration with
Tier 1 Vendor Software

(eg: Vendor Web Services, direct access to to vendor DB)

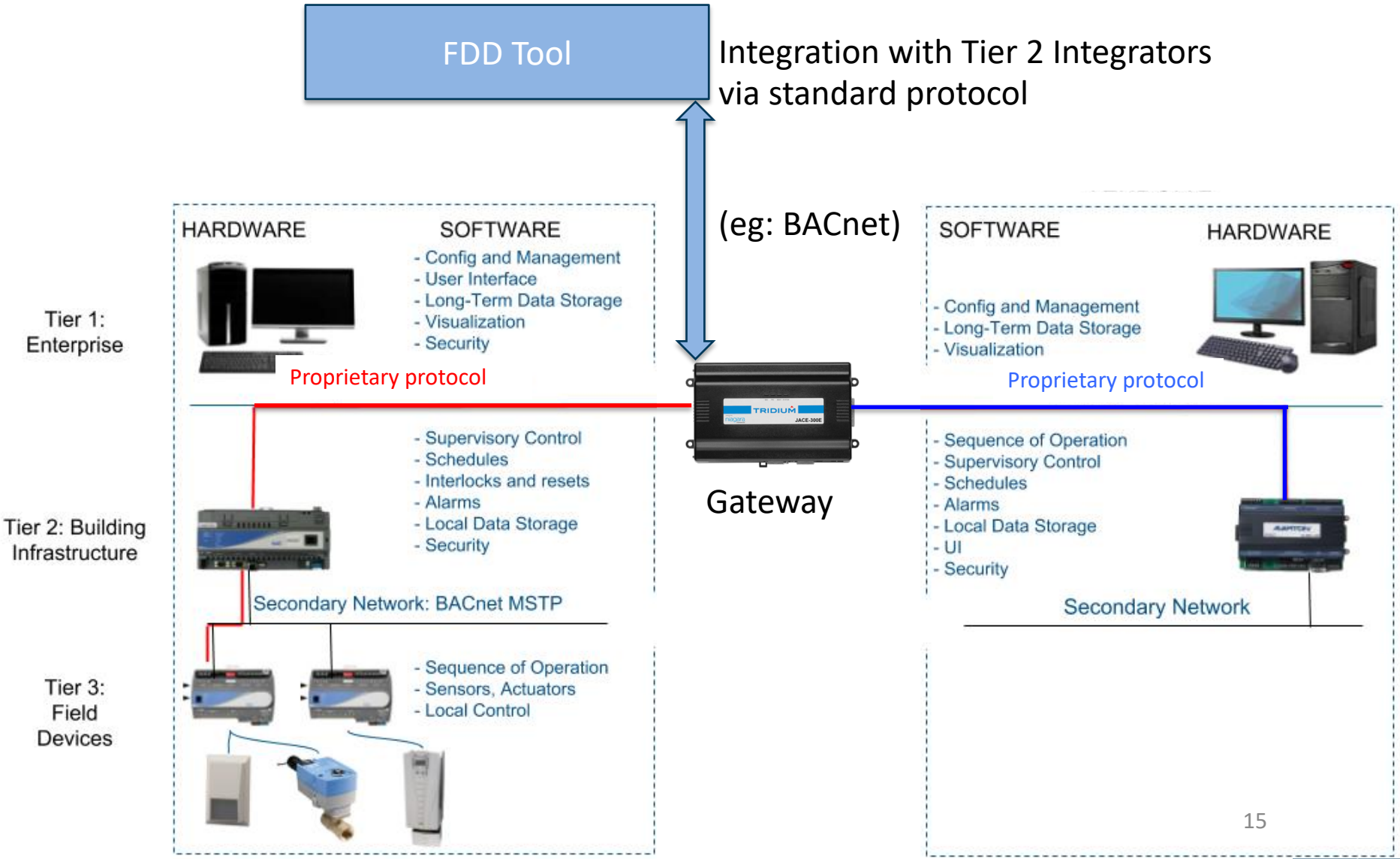
Fault Auto-Correction Architecture



Integration with Tier 2 Controllers via standard protocol

(eg: BACnet)

Discussion, Fault Auto-Correction Architecture



Test Plan and Site Selection (Q2)

- Test plan to evaluate correction solutions vs base case, define metrics, required data, duration and content of test cases, and evaluation process to determine, e.g.
  - Ability to correct identified faults without adverse operational effects [t/f for each tested]
  - Reduction in fault 'residence time' before a fix is implemented [e.g., no., %]
  - Reduction in complaint calls [e.g., frequency of occurrence, no., %]
  - Reduction in labor cost to implement fixes [e.g., $]
  - Additional qualitative benefits
- Site selection criteria and survey and identify test sites, share with advisory partners and DOE for acceptance

Discussion

- Questions to clarify intent, scope, other?
- Thoughts on technical details associated with correction routines?
- General comments?

Next Steps

- Send kickoff meeting deck, notes
- Joint work to review, further define auto-correction approaches
- Begin drafting test plan and site criteria

Thank you!

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